D. Hitlin, I. Narsky, and D. Doll are working on measuring the branching fraction $B^+ \rightarrow K^+ \nu \nu$. Flavour-changing neutral current decays, such as $b \rightarrow s\nu\nu$, only enter the Standard Model at the loop level and are therefore highly suppressed. Various new physics (NP) models (Generic SUSY models, Strong electroweak symmetry breaking, etc. [1]) can enhance the branching fractions of such decays by about an order of magnitude (raising the Standard Model predicted branching fraction of $0.38^{+1.2}_{-0.6} \times 10^{-5}$ to $\leq 2 \times 10^{-5}$). Measurement of this decay therefore probes physics beyond the Standard Model and constrains the parameter space for alternative models.

In 2004 BABAR published an upper limit [2] on $B^+ \rightarrow K^+ \nu \nu$ using 81.9 fb$^{-1}$ of data. Our analysis will improve the published measurement of $B^+ \rightarrow K^+ \nu \nu$ using more statistics (338 fb$^{-1}$ of data) and a new multivariate technique for separation of signal from background [3].

We have applied our analysis technique to the 81.9 fb$^{-1}$ of data used for the published Babar measurement of $B^+ \rightarrow K^+ \nu \nu$. First, we have optimized a set of orthogonal selection requirements in the multivariate space and obtained a sensitivity comparable to that in the published analysis (a signal efficiency of $1.35 \times 10^{-3}$ and an expected $8.40 \pm 3.17$ background events with the new requirements, versus an efficiency of $1.23 \times 10^{-3}$ and an expected 7.7 background events in the published results). Then we applied the random forest technique [3] to the same dataset. The new technique suppresses the background component by a factor of 3 at the same signal selection efficiency (Fig. 1).

We have also optimized a set of orthogonal selection requirements on 205 fb$^{-1}$ of data (corresponding to the data from "run 1" to "run 4"), and plan to use these results as our selection requirements on the entire data set of 338 fb$^{-1}$ (which includes "run 5"). Our analysis seeks to optimize the "Punzi" Figure of Merit ($Signal/\sqrt{Background + a/2}$, where $a$, expressed in standard deviations, is the statistical significance of the expected signal) [4]. The signal efficiency decreases to $0.90 \times 10^{-3}$, but the figure of merit improves from 0.096 for the previously published results to 0.146 for run 1 through run 4. The next step will be to apply the random forest technique to improve these results even further. We are currently working on obtaining a control sample consisting of events where both B mesons decay through the channel $B^+ \rightarrow D^{0} l^+ \nu$ to evaluate the systematic uncertainties associated with the random forest technique.

References


Figure 1: Expected background versus signal efficiency for the random forest technique with the published results and multivariate (bump hunter) technique shown.